RAW MATERIALS

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REFRACTORY CLAYS OF THE TORETSKOE DEPOSIT

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Refractory clays of the Toretskoe deposit (Donetsk Region) are described. These clays are white-burning clays and can be used in the production of high-quality porcelain and ceramics for various destinations.

Owing to their unique properties, Ukrainian clays have acquired a good reputation among ceramic manufactures [1]. One of the main suppliers of high-quality clay for the world market is the Donkerampromsyr'e Company, which is working the Toretskoe deposit of refractory and high-melting clays.

The deposit is located in the Dobropolskii district of the Donetsk Region and shares a common geological level of Neogenic clays with the Oktyabr'skoe, Yuzhno-Oktyabr'skoe, and Kucherovoyarskoe deposits. The prospected resources of the deposit comprise 16.9 million tons.

Clays from the Toretskoe deposit have been analyzed in the laboratories of the Artemovsk Geology Survey Company, Donkerampromsyr'e JSC, and Marazzi Gruppo Ceramiche Spa.

The Toretskoe clays are highly-sintering white-burning clay varieties [2]. The main application areas for such clays are production of ceramic tiles and porcelain ware,

The pelite structure prevails in clays of the Toretskoe deposit. The majority of these clays have medium or high dispersion. The content of the fraction below 0.005 mm is 85 – 95%. Only low-grade clays have 70 – 80% of this fraction. As for the coarsely dispersed fractions, the typical content of the fraction over 0.063 mm in clays of grade A is 0.8%, 1.6% in grade B, 0.7 – 5.0% in grade C, 3.0 – 8.0% in grade D, and 2.0 – 7.0% in grade D1.

According to mineralogical analysis data, the main minerals in Toretskoe clays are imperfectly crystallized kaolinite, hydromica dehydrated to different degrees, a swelling phase, and quartz. A specific technological property of this type of clay, i.e. a high degree of sintering at relatively low temperatures, is due to the swelling phase, which is a special component typical only of this type of clays. It consists of disordered mixed-layer formations of a hydromica-monmorillonite composition [3]. The average mineralogical composition of clay is (%): 63 kaolinite, 8 hydromica, 22 mixed-layer phase, and 7 finely dispersed quartz. Traces of feldspar, anatase, and ciderite are found as well.

Based on their chemical composition, Toretskoe clays are acid and semiacid. Their compositions are diverse. Thus, the content of aluminum oxide varies from 13 to 33% (predominantly 18 – 30%), and that of iron oxide from 0.3 to 5.0%; however, the majority of clays contain 0.65 – 1.30% Fe_2O_3. A low content of iron (0.4 – 0.6%) is typical of sand clays with a low content of aluminum.

Figure 1 shows the content of Al_2O_3 and Fe_2O_3 in more than 8000 samples. It can be seen that the minimum content of iron depends on the content of aluminum in the sample. Thus, there are many samples with 15% Al_2O_3 containing not more than 0.5% Fe_2O_3. At the same time, the upper bound of Fe_2O_3 content depending on the content of Al_2O_3 is not clearly determined. The content of TiO_2 fluctuates to a much lesser extent and comprises 0.90 – 1.95%. Clays with 1.2 – 1.7% TiO_2 prevail. Toretskoe clays have a relatively

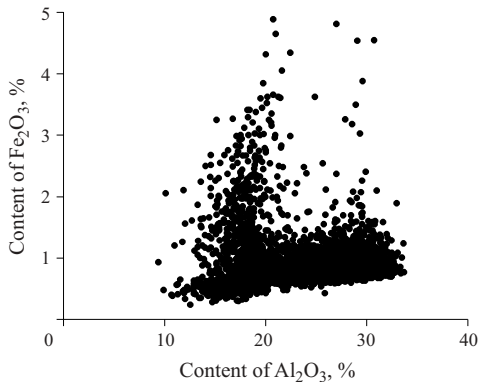

Fig. 1. Content of Al_2O_3 and Fe_2O_3 in Toretskoe clay samples.

[1] Donkerampromsyr'e Company, Donetsk Region, Ukraine.

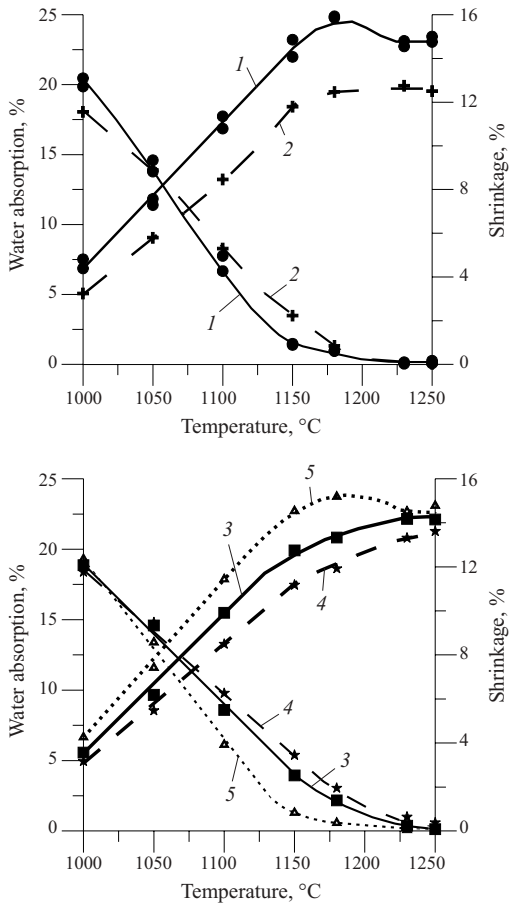

Fig. 2. Temperature dependence of shrinkage and water absorption of Toretskoe clays of grades A (*1*), E (*2*), C (*3*), D (*4*), and D1 (*5*).

high content of oxide: from 1 to 3% with prevalence of 1.90 – 2.65%. According to the data in [3], this is a positive trait, since with increasing content of K_2O the sintering interval of the clay expands.

The content of the pigment oxides ($Fe_2O_3 + TiO_2$) is of great significance for clay used in the production of ceramic articles, especially of porcelain. This parameter for Toretskoe clays varies from 1.2 to 6.0%. In high-grade clays with an oxide aluminum content over 30% the sum of the colorant oxides varies from 1.8 to 3.0% (mainly 2.0 – 2.5%). Calcination loss at a temperature of 1000°C varies from 2 to 11% (as a rule, 4 – 10%).

Sintering shrinkage and water absorption of fired clay samples are very important parameters for ceramic production. Figure 2 shows the dependences of these parameters on the sintering temperature for Toretskoe clays. It can be seen that the sintering temperature (maximum shrinkage) for clays with a high content of aluminum (grades A and D1) is 1180°C. For grades C and D, the sintering temperature is higher: 1200 – 1230°C. At the same temperatures water absorption stops decreasing.

The refractoriness of Toretskoe clays of grade A is 1650°C, of grade C is 1645°C, and of grade D is 1550°C.

The color of fired samples depends on the firing temperature and the clay composition. Clays with a low content of iron after firing have a creamy-grayish shade. Clays with an increased content of Fe_2O_3 have a pink color after the first firing. At a higher firing temperature the color becomes more intense and changes its shade: clays with a low content of Al_2O_3 have a pinkish-red shade, whereas clays with a high content of Al_2O_3 have a dark gray color, which becomes gray-brown with a Fe_2O_3 content more than 3%.

The majority of Toretskoe clays have medium plasticity. Clays with plasticity number from 17 to 26 prevail. The yield strength varies from 33 to 60%, and the plastic limit ranges from 21 to 30%.

With respect to radiation-hygienic parameters, Toretskoe clays are classified as application class I, which means that products made of these clays are suitable for all kinds of construction work.

Thus, Toretskoe clays have all the advantages typical of Ukrainian white-burning kaolinite clays and can be successfully used in the production of high-quality ceramics.

REFERENCES

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